CHAPTER 6

AFLOAT LUBE OIL AND MOGAS SYSTEMS AND OPERATIONS

The catapult cylinder lubricating system on board aircraft carriers is maintained by the Aviation Fuels Division (V-4). The MOGAS system is also maintained and operated by the ABF. Both are discussed in this chapter.

CATAPULT LUBRICATING OIL SYSTEM

LEARNING OBJECTIVES: Describe a typical afloat lube oil system. Explain correct lube oil system operating procedures.

Although lube oil systems vary from ship to ship, an ABF qualified in one system can qualify quickly in the operation and maintenance of other lube oil systems. Lube oil systems were intended for the storage and distribution of reciprocating engine oils and to supply oil to operate the ship's catapults. With the decline in use of piston engine aircraft, lube oil systems are now used solely to supply lubricating oil to the ship's catapults. Oil used in jet engines is provided in sealed cans and handled through the Supply Department.

The lube oil system (fig. 6-1) is a separate, independent system. It is composed of a storage tank, one or two pumps, valves, and piping. The piping is arranged to supply two (or four, based one which ship you are on) ready service tanks, located in the catapult spaces. The pumps take suction from the manifolds connected to the lube oil storage tank and discharge through a manifold to the riser going to the service tanks. It is a simple system that is simple to operate and maintain.

OPERATIONS

Operation of the lube oil system is done IAW the Aviation Lube Oil Operational Sequencing System (ALOSS). The piping is arranged in the pump room so that the following operating conditions may be obtained:

- Either or both pumps may simultaneously take suction from the storage tank, and discharge to any ready service tank.

NOTE

Some lube oil systems have only one pump.

- Either or both pumps may take suction from the fill line, and discharge to the storage tank during the filling operation.

- Either or both pumps may simultaneously take suction from the storage tank, and discharge for offloading of lube oil.

NOTE

In the lube oil spaces, a 4JG sound-powered phone is installed for constant communication between the pump room operator and catapult personnel during actual pumping operations to the service tanks.

Filling the Storage Tank

The storage tank may be filled by any of the following methods:

- POURING FROM DRUMS. Screw a large funnel into the filling connection; raise the drum above the filling connection by using a forklift or other means; and open the large cap. The large cap should be on the bottom, near and over the funnel. Next, open the small cap on top to allow air into the drum. The amount of oil leaving the drum can be controlled by opening and closing the top cap.

- SIPHONING FROM DRUMS. Rig a 1 1/4-inch gasoline nozzle with a brass nozzle long enough to reach to the bottom of the drum. Then rig a hose from the nozzle with a fitting into the filling connection. With this method, the vacuum from the lube oil pumps may be used for loading.

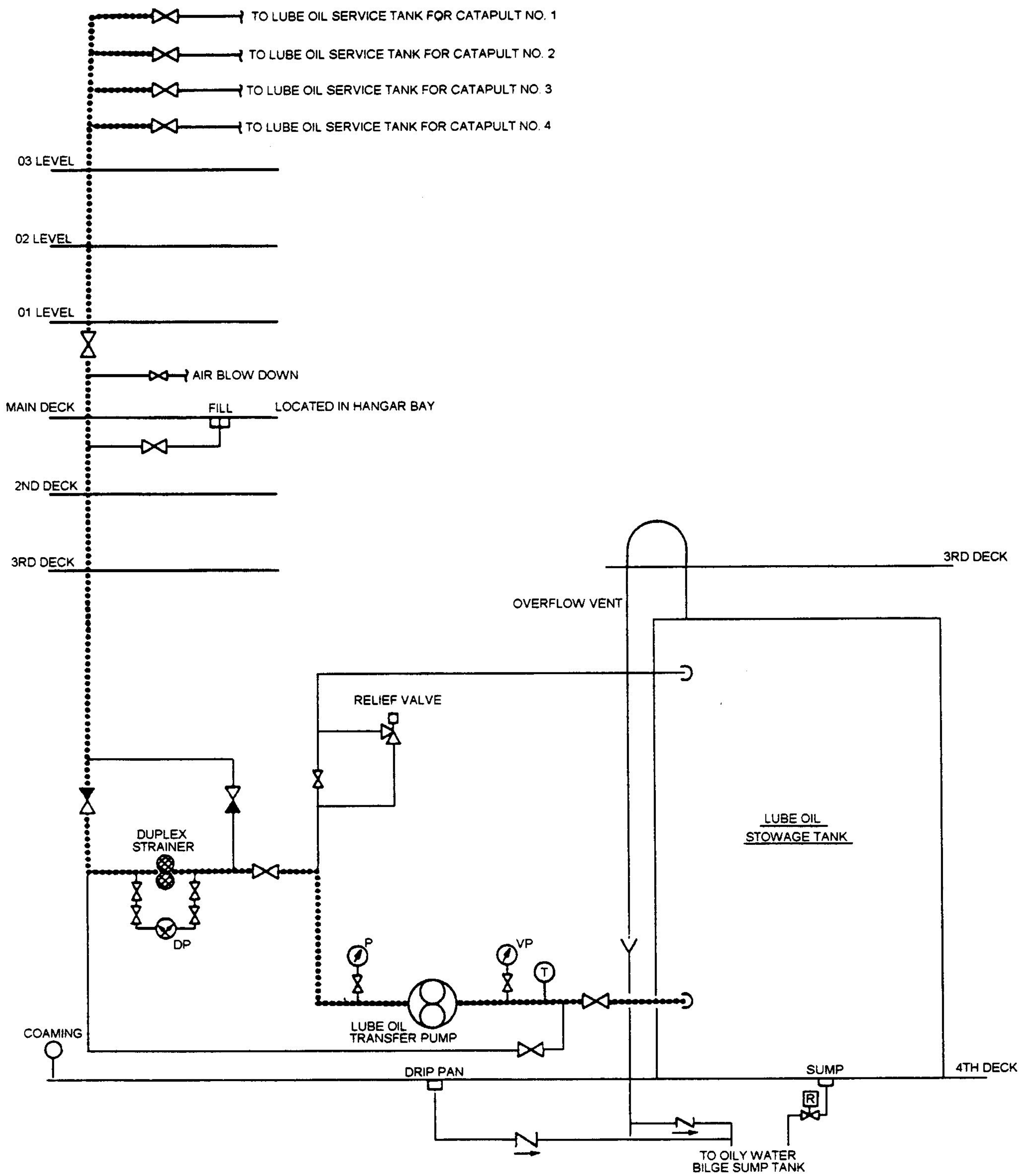


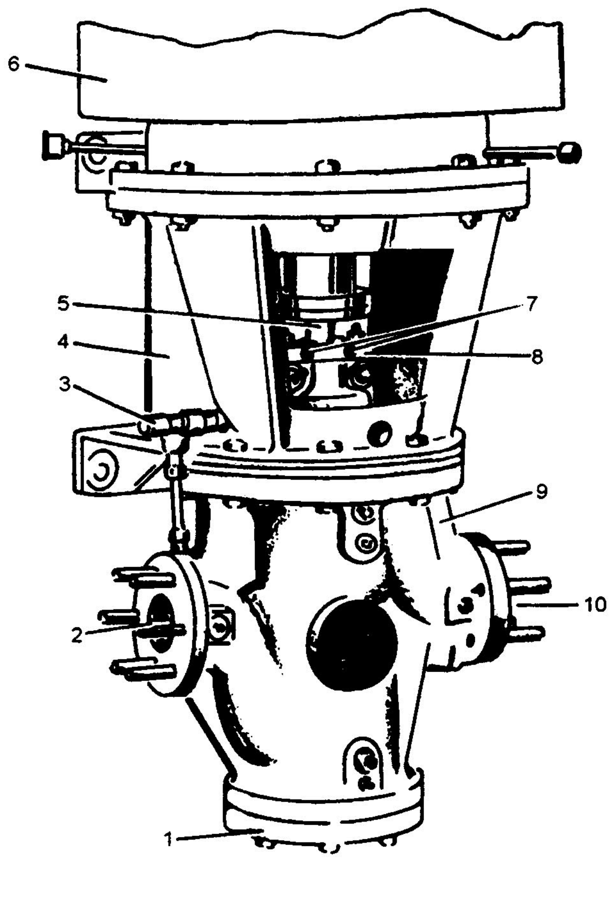
Figure 6-1.—Typical lube oil system.

• LOADING FROM A TRUCK ON THE DOCK. Rig a direct line from the truck to the filling connection. With this method, a pump on the truck is used to boost the oil from the truck to the filling connection.

CAUTION

When loading from struck on the dock, use caution to ensure that the pressure from the truck to the lube oil system is not enough to cause damage to hose, piping, or pumps.

When the system is taking on lube oil, a vent is not necessary, because the system is vented through the tank to the overflow tank. The valves from the tank to the overflow tank are locked open during this operation. To allow for expansion, tanks should not be filled beyond 90% capacity.



1. Lower end cover
2. Suction connection
3. Relief valve
4. Shaft housing
5. Shaft
6. Power unit
7. Adjusting screws
8. Packing gland
9. Pump case
10. Discharge connection

Figure 6-2.—Typical rotary-screw lube oil pump.

Lube Oil Pumps

Numerous lube oil pumps are installed on Navy ships, and it would be nearly impossible to cover each one. This manual will cover an older pump, the De Laval 31P156.

The De Laval 31P156 is a vertical, single-stage, positive displacement, rotary-screw pump (figs. 6-2 and 6-3). The pump consists of a power rotor (which moves the oil), two idler rotors (for sealing), the housing, thrust elements, shaft packing, and piping connections.

When the pump is started for the first time or after a long period of idleness, follow the instructions for initial starting, given below.

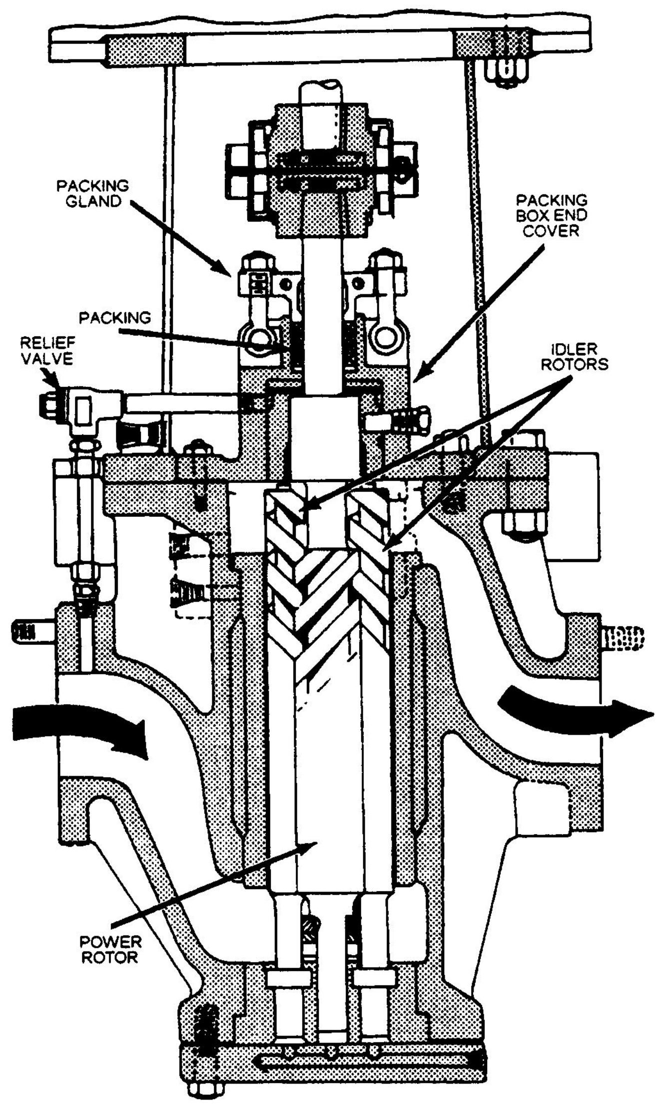


Figure 6-3.—Rotary-screw pump (cutaway).

INITIAL STARTING.— All external surfaces of the pump should be carefully cleaned before the pump is started. If the factory assembly has not been disturbed, it will not be necessary to dismantle the unit for cleaning. The interior of the pump was coated with a special rust-preventive compound after the factory test. The removal of this compound is effected completely without any harmful results in the normal operation of the unit.

Make sure that the shaft packing has been installed and that the gland nuts are only fingertight.

Before you start the pump, prime it by filling the pump case and as much of the suction line as possible with oil. If the air is not removed from the suction line, the performance of the unit will be erratic, or it will not pump at all. If no priming connection is provided, use the plug on the suction connection of the pump.

Open the suction, discharge, and vent valves and start the motor. If the pump is moving the oil satisfactorily, the vent valve may be closed after a few minutes of operation. Allow the shaft packing to leak freely for the first 15 minutes of operation; then, tighten the gland nuts with your fingers until there is only a slight leakage past the packing.

If the pump fails to discharge after starting, stop the motor, prime the pump again, and restart the pump. If it still does not pickup oil immediately, there may be a leak in the suction line, or the trouble may be traced to excessive suction from an obstruction, throttle valve, or other causes. Connecting a gage at several points along the suction line, while the pump is operating, helps locate the trouble. An obstruction in the suction line causes an observable drop in pressure at the point of obstruction, the lower pressure being on the pump side.

CAUTION

Operating the pump without oil causes rapid wear of the housing and bearings; therefore, checks for trouble must be made quickly and systematically.

ROUTINE STARTING.— Open the suction and discharge valves and start the motor. Ensure that oil is being pumped and that there is a slight leakage past the shaft packing. Read the gages that indicate the suction and discharge pressures for the pump, and make sure the pump is operating normally. If it is not pumping, follow the instructions for initial starting.

OPERATION.— After the pump is in service, it continues to operate satisfactorily with little or no need for maintenance except normal PMS. The suction and discharge pressures should be checked at least every 10 minutes to verify the performance of the pump. Once each day, the shaft packing should be inspected to see that it is properly adjusted. Any unusual conditions should be noted and investigated.

SECURING.— Stop the motor and close the suction and discharge valves.

Maintenance

De Laval pumps require very little attention in normal usage. Unless they are operated without oil or with oil containing abrasive particles, their operation without major overhaul is virtually unlimited.

The pump is equipped with a relief valve to prevent excessive oil-pressure buildup. The relief valve also seals the metallic packing against air leakage during suction lift conditions.

There is a set of packing located in the packing box end cover (fig. 6-3). The four flexible, metallic packing rings are installed with the joints of abutting rings staggered, and they are held in place by a packing gland. This packing gland is split to allow packing replacement without disturbing the other elements of the pump. The two sections of the packing gland are held together with two screws, and the gland pressure is adjusted with two gland nuts. This adjustment should be sufficient to allow a slight amount of leakage past the packing for lubrication of the packing.

Inspection

An inspection made while the pump is operating discloses any leakage between the end covers and case or in the piping connections. If leakage is observed, it may be due to foreign matter on the gaskets, defective gaskets, or loose nuts and bolts. Replace the gaskets or tighten the nuts and bolts as required.

Lubrication

The pump does not require any lubrication, since the oil being pumped lubricates all the moving parts. Driving-unit lubrication instructions are provided with each unit.

Operating Troubles

Some operating troubles may be evident from a low discharge pressure, excessive or unusual noise, or an overloaded driving unit. The following paragraphs discuss the most likely causes of operating troubles.

LOW DISCHARGE PRESSURE.— A low discharge pressure generally indicates that not enough oil is being pumped. This condition may exist because the pump needs priming or because of leakage. A gradual decrease in discharge pressure over a period of time is generally the result of pumping oil that contains abrasive particles, which causes the housing and rotors to wear.

NOISE.— Excessive or unusual noises may be caused by cold oil, dirty strainers, air in the oil, vaporization of the oil because of increased temperature, or misalignment of the coupling.

OVERLOADED DRIVING UNIT.— Excessive friction in the pump or in the driving unit can cause a driving unit to be overloaded. Misalignment of parts when the pump is reassembled increases friction. Overloading may also be caused by faulty operation of the system, heavy or cold oil, or from other causes that are not due to actual malfunctioning of the pump.

MOGAS SYSTEMS AFLOAT

LEARNING OBJECTIVES: Describe the typical afloat MOGAS system. Identify the protective systems for afloat MOGAS components. Explain the correct operating procedures for afloat MOGAS systems.

As an ABF assigned to LPD and LHA ships, you will be working with motor gasoline (MOGAS) systems. As with JP-5 systems, each ship is different, even ships within the same class. As older equipment is replaced with newer equipment, the uniformity among ships will increase until firm standardization evolves.

Most equipment used in a fixed MOGAS system, such as pumps, valves, and filters are identical to the same equipment used in the afloat JP-5 system only smaller. This chapter will cover the major areas within a typical fixed MOGAS system aboard an LHA and the equipment unique to this system. Other class ship's systems are slightly different. For specific system information and operation and maintenance procedures onboard your ship, refer to your ship's *Cargo Fuel Operational Sequencing System* (CFOSS) manuals.

The theories and laws of physics apply to all fuel systems, but you must understand them completely before you attempt to operate a fixed MOGAS system.

U-TUBE PRINCIPLE OF THE MOGAS SYSTEM

Hydraulics is the study of the behavior of fluids in their application to engineering problems. The fundamental law underlying the whole science of hydraulics was discovered by the French scientist Pascal, in the seventeenth century. Pascal's law states: "Any pressure or force applied to a confined liquid will be transmitted equally and undiminished in all directions, regardless of the size or shape of the container."

Liquid seeks its own level. The surface of the water in a teakettle is at the same level in the spout as it is in the body of the kettle. This rule also applies when a liquid is introduced to several differently shaped, openly connected tanks. The surface of the liquid would be at the same level in each connected tank.

The two liquids handled in the MOGAS system are seawater and gasoline. A cubic foot of seawater weighs 64.0 pounds, while a cubic foot of gasoline weighs 45.8 pounds. Since gasoline is lighter than seawater, it will float on top of the seawater and not mix with it.

A U-tube analogy to the MOGAS system, shown in figure 6-4, is based on two principles:

- The weight per unit volume of gasoline is less than that of seawater. Therefore, the gasoline will float on the surface of the seawater.

- A given head of seawater in a U-tube will hold in balance a greater head of gasoline because the gasoline is lighter than the seawater.

The MOGAS system on the ship is really a giant U-tube. The saddle storage tank containing seawater and gasoline forms the bottom of the tube. The seawater piping forms one side of the tube, and the gasoline piping forms the other side.

The installation is designed to keep the gasoline storage tanks entirely full at all times, either with gasoline on top of the seawater or completely with seawater. As gasoline is drawn off, water replaces it,

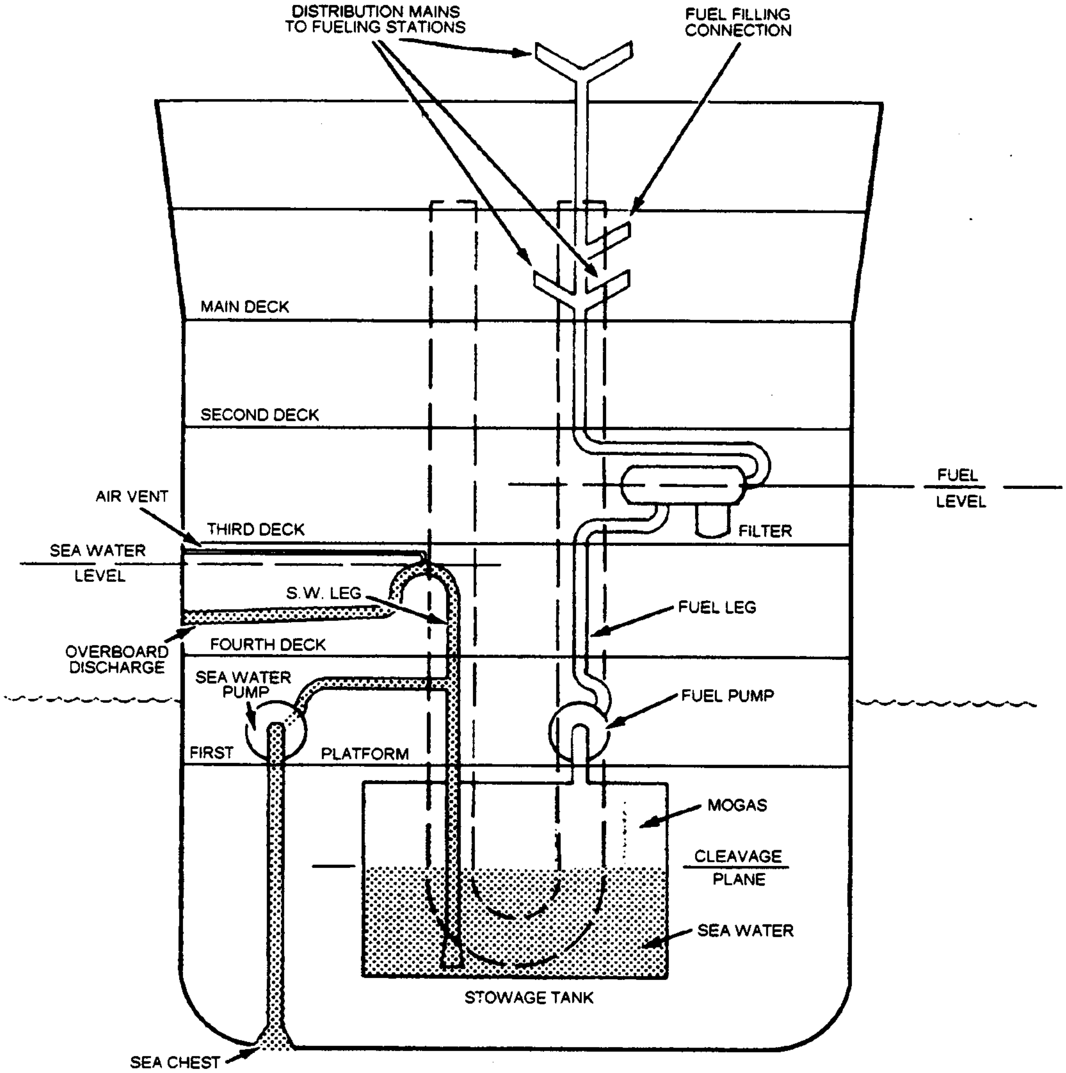


Figure 6-4.—U-tube analogy of the MOGAS system.

and no air pockets can form to hold explosive mixtures of gasoline vapor and air. The constant pressure applied by seawater is maintained by the elevated loop design in the seawater system.

STORAGE TANKS

The saddle-type storage tanks (fig. 6-5) of the MOGAS system are designed to provide the greatest possible safety for the storage of gasoline.

A storage tank actually consists of two tanks—an outer tank and a drawoff tank—and a cofferdam. The outer tank encloses the drawoff tank, and a cofferdam surrounds the outer tank. The cofferdam is part of the protective system and is filled with nitrogen (N2) or carbon dioxide (CO2) for protection against fire and explosion.

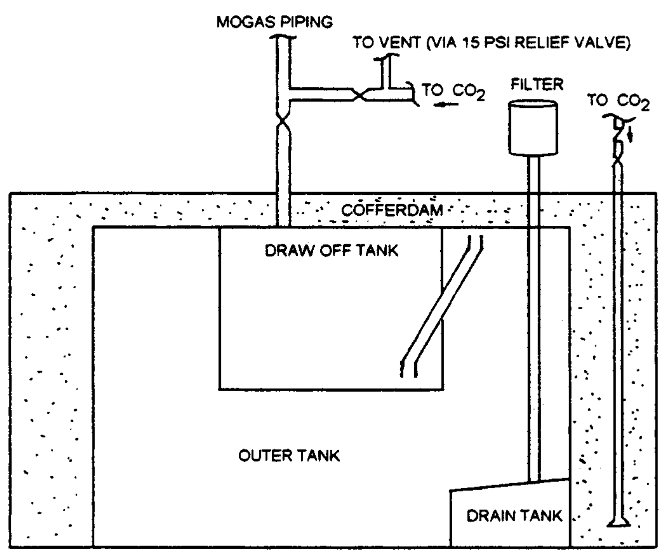


Figure 6-5.—MOGAS saddle-type storage tank.

A manhole cover is provided in the top of each tank to gain access for cleaning and maintenance. A Buns-N-Cork gasket is installed between the tank and manhole cover plate to prevent leakage. The outer tank manhole cover plate is fitted with a steam-out connection.

Outer Tank

The seawater supply riser enters the outer tank at the top and terminates in a diffuser near the bottom. The seawater required for pressurizing the tanks is discharged through this line.

A pressure gage line extends from the top of the outer tank to a pressure gage located in the pump room. The gage has a red pointer, indicating the maximum allowable tanktop pressure for that set of tanks. (Allowable pressures will vary for the different classes of ships.) A warning plate attached near each gage reads, "THE MAXIMUM ALLOWABLE TANK-TOP PRESSURE INDICATED BY THE FIXED RED POINTER SHALL NOT BE EXCEEDED WHEN THE SHIP IS FUELED."

Two in-tank reservoirs for water-filled, static-head gasoline gages are installed in the outer tank. One reservoir is installed at the top of the tank and the other at the bottom directly underneath the upper reservoir. Stuffing boxes are provided where the tubing for the gage passes up through the outer tank. The stuffing boxes prevent leakage of gasoline and seawater out of the tank. They also prevent nitrogen in the cofferdam from entering the tanks.

NOTE

LPDs have water filled, static-head gages but are scheduled to have them replaced with TLIs. LHAs already have TLIs.

The outer tank is interconnected with the drawoff tank by a sluice pipe. The sluice pipe extends from near the top of the outer tank and terminates in a diffuser at the bottom of the drawoff tank. The top of the sluice pipe is flared to reduce friction. The outer tank completely envelopes the drawoff tank.

The outer tank has a motor-driven stripping system installed for deballasting the tank. The independent hand-stripping system also ties into the outer tank to remove water and sludge from the bottom of the tank.

Draw-off Tank

The draw-off tank is the smaller of the two tanks. It is the tank from which gasoline is drawn when servicing or off-loading fuel. It is the first tank filled when MOGAS is being received and the last tank emptied when MOGAS is being off-loaded.

The gasoline supply riser extends from the extreme top of the drawoff tank to the common suction header of the gasoline pump. The recirculating header terminates in a diffuser at midpoint in the draw-off tank.

The draw-off tank is provided with an independent stripping system to remove water and sludge from the bottom of the tank. This system is the same hand-operated type used with the JP-5 service tanks. The suction line is fitted with a shutoff valve and extends from three-fourths of an inch off the bottom of the lowest part of the tank. The discharge line, fitted with a sight glass, test connection, one-way check valve, and a shutoff valve, terminates in two places: 24 inches off the bottom of the outer tank, and overboard.

The draw-off tank also has a water-filled, static-head gage, or a TLI.

Drain Tank

The drain tank is a small tank located inside the outer storage tank. The drain tank stores contaminated MOGAS/water that is filtered/separated out of the MOGAS.

Cofferdam

The cofferdam provides two-fold protection for the storage tanks. The cofferdam is normally kept charged with nitrogen (N_2) to 3 psi at 50% inertness or carbon dioxide (CO_2) at 35% inertness to reduce fire and explosion hazards. It also collects any leakage from the storage tanks.

The nitrogen supply line for purging and charging the cofferdam terminates in a loop, which completely encircles the outer tank. From this loop (located near the top of the cofferdam), pipes (legs) extend down to near the bottom. Each leg is fitted with a diffuser, which serves to spread the inert gas throughout the space. A stop valve for controlling the nitrogen entering the tank is located in the main supply line at the pump room level.

An air escape riser, fitted with a shutoff valve, extends from the top of the cofferdam and vents to atmosphere at the 02 level. A bypass line is installed around the shutoff valve. This line contains a sure-relief valve (set at 4 psi), a pressure gage, and a portable inertness analyzer connection.

A fixed eductor is installed in the cofferdam to remove any seawater or gasoline that might escape from the storage tanks. The eductor is fitted with two suctions: one near the centerline at the forward end of the cofferdam and the other near the centerline at the after end of the cofferdam.

The controls for the eductor are located in a watertight box on the pump room deck.

Two static-head liquid-level gages, or electronic sensors, are installed in each cofferdam to indicate the presence of leakage into the compartment. One is located on the centerline in the forward end of the cofferdam and the other on the centerline in the after end. This arrangement makes it possible to determine the presence of leakage, regardless of the trim of the ship.

Access to the cofferdam is gained through a bolted manhole cover in the pump room deck. Normally, the cofferdam manhole cover is located directly over the outer tank manhole cover.

Storage Tank Diffuser

The diffuser (fig. 6-6) reduces turbulence when gasoline or seawater enters the storage tanks. Diffusers are mounted on the bottom of the gasoline storage tanks around the end of each sluice pipe and seawater supply riser. They are bolted to clips or brackets that are welded to the bottom of the tank and to the bulkhead.

The diffuser is a perforated cylinder with an open bottom, and it has a top plate with an opening for the gasoline or seawater supply pipe. The opening in the top plate is larger than the outside diameter of the supply pipe, which permits the pipe to move with the movement of the ship's structure. The total area of the perforations in the diffuser is five times that of the area of the supply pipe. Gasoline or water enters the diffuser in a single stream and is broken into smaller streams as it passes through the holes in the cylinder. The distribution of flow over a large area reduces turbulence.

Gaging Equipment

Two different types of gages are currently used in the gasoline tanks to determine the amount of gasoline within the tanks. These gages are the water-filled, static-head type, and the TLI.

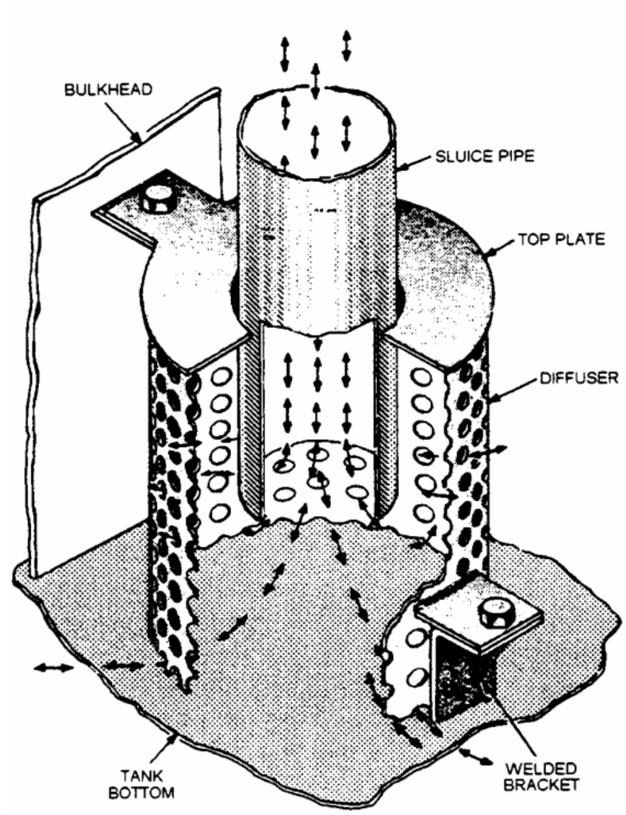


Figure 6-6.—MOGAS storage tank diffuser.

The water-filled, static-head gasoline gage (figs. 6-7 and 6-8) provides an accurate means of determining the amount of gasoline in the saddle-type storage tanks. It accomplishes this task by sensing the differential created, as the plane of cleavage between

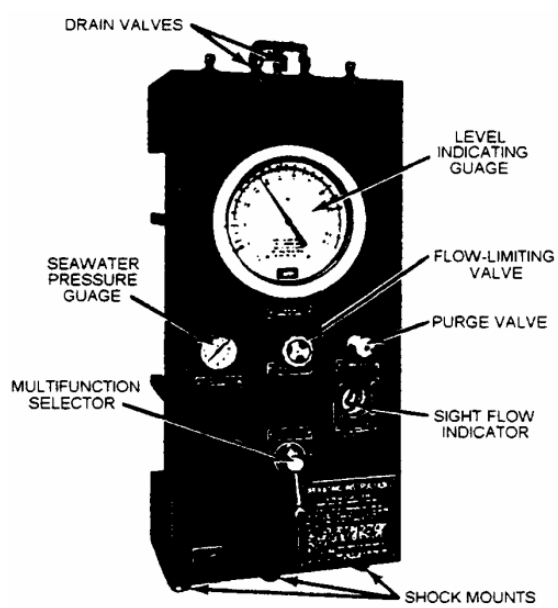


Figure 6-7.—Level indicating panel (front view).

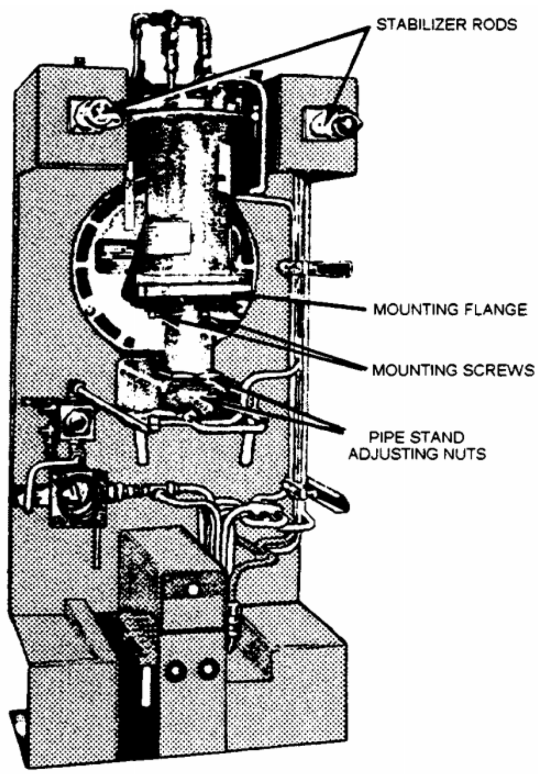


Figure 6-8.—Level indicating panel (rear view).

the two liquids (gasoline and seawater) varies and converts this differential to gallons of gasoline. There are four components to this gage:

• In-tank reservoir, an upper and lower reservoir for each of the inner and outer tanks (a total of four reservoirs)

• A panel in the pump room, which contains the following:

Differential pressure gage

Multifunction selector

Flow-limiting valve

Seawater pressure gage

Purge valve

Flow indicator

Operating instructions

• Water-filled connecting lines connect the in-tank reservoirs to the gage panel.

• Seawater supply for purging consists of the following:

Firemain cutout valve

Strainer

Pressure-reducing valve

Pressure gage

Bypass purge line

Bypass purge valve

Most of the components are installed to aid in purging the system. Only three items are necessary for the actual gaging of the tanks. These are the differential pressure gage, water-filled connecting lines, and the upper and lower in-tank reservoirs.

When the storage tanks are full (100%) of seawater, a constant differential pressure exists between the upper and lower in-tank reservoirs, and the differential pressure gage reads ZERO. As the storage tanks are filled with gasoline, a varying differential pressure is developed between the upper and lower in-tank reservoirs. This varying differential pressure, created by the difference in specific gravities of the two liquids (gasoline and seawater), is transmitted to the gage panel through the water-filled connecting lines. The differential pressure gage senses this varying differential pressure and converts it to gallons of gasoline present in the storage tank.

The differential pressure gage (fig. 6-9) measures the varying pressure differential from the tank and

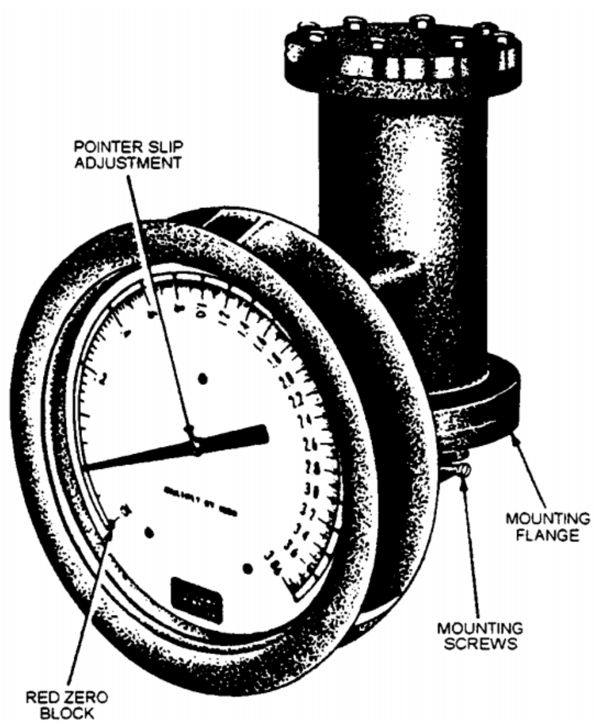


Figure 6-9.—Differential pressure gage.

indicates its findings on a dial that is calibrated in gallons. This gage consists of three basic units: the bellows, torque tube, and dial mechanism.

The flow indicator (fig. 6-10) provides visual identification of the flow of seawater through a pipeline. The indicator has a hinged flapper suspended from the body so it rests against the inlet passage at no flow. As liquid begins to flow, the flapper swings outward to a position generally proportional to the flow rate.

The in-tank reservoir connecting lines are gasoline-tight, cylindrical tanks with a nontight flanged cover. They are open to liquid pressure near the top by two holes directly opposite each other. The in-tank reservoirs are brazed to the ends of connecting lines. One is located near the top of the tank and the other located near the bottom of the same tank. Connecting lines terminate 1/2 inch off the bottom of the reservoir. The in-tank reservoirs are filled with seawater because of purging. The connecting lines are purged with seawater to prevent gasoline from entering the pump room through the lines.

The flow-limiter valve is a globe-type needle valve used to reduce seawater pressure to the desired pressure. It is located between the firemain supply and the purge valve.

The seawater pressure gage indicates the pressure of the seawater supply and is located between the flow-limiter valve and the purge valve.

With one exception, the TLI used in MOGAS tanks is just like the TLI used in JP-5 tanks. The float for the TLI used in MOGAS systems is constructed of Hycel. This material is designed to float on water and sink in fuel. That means the float will be at the cleavage line (interface) of the water and MOGAS. Refer to chapter 4 for information on TLI components and operations.

SEAWATER PIPING AND VALVE ARRANGEMENT

The seawater system supplies seawater (under pressure) to the outer tank to force gasoline up to the transfer (gasoline booster) pump. It also provides a means for flushing and draining the storage tank, and limits the

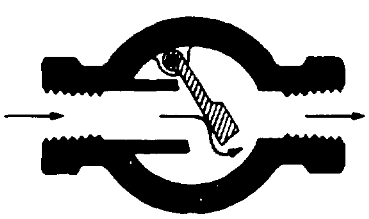


Figure 6-10.—Flow indicator.

amount of pressure that can be applied to the tanks at maximum pump capacity.

Seawater is supplied directly from the sea, through a sea chest located in the cofferdam around the storage tanks. A steel grating installed in the opening of the ship's bottom prevents large objects from being drawn into the system. Steam is used for cleaning out the sea chest in the event of clogging. Steam has a two-fold effect for cleaning purposes. It can be supplied at an adequate pressure for blowing out any debris, and it also provides a "cooking effect" to remove remaining gasoline vapors as well. A shutoff valve is located between the sea chest and the sea chest supply riser. This valve is LOCKED OPEN.

The sea chest supply riser connects directly to the suction header of the seawater pump. An additional shutoff valve is installed in this line at the pump room level.

The motor-driven, centrifugal seawater pump is located in the MOGAS pump room, and the motor is in the adjacent pump motor room. The shaft connecting the pump to its motor passes through a watertight stuffing box in the bulkhead. The pump takes suction from the suction header and discharges into a discharge header. The pump suction line is fitted with a basket strainer, a one-way check valve, and a compound gage. The discharge line contains a pressure gage and a shutoff valve. On centrifugal pumps, the pump inlet is always larger than the discharge line.

NOTE

LPDs have a separate seawater pump room, located in the starboard shaft alley.

The discharge header is connected to the outer tank seawater supply riser and the seawater expansion tank fill line. Shut off valves installed in this line can be used to direct pump discharge pressure into the outer tank for pressurizing the system during normal operations or filling the expansion tank.

The expansion tank is a 500-gallon tank kept full of seawater. Its purpose is to keep the MOGAS tanks full at all times by compensating for contraction of the MOGAS.

The outer tank seawater supply riser terminates in a diffuser at the bottom of the outer tank. This line contains a spectacle flange (or pipe blind) and a steam-out connection. The spectacle flange is rotated to the closed position when steam is injected either here or at the outer tank manhole cover for steaming tanks.

The overboard discharge line is led upward in a loop from the expansion tank and then overboard just above the third deck level. The height and size of the overflow loop act as a relief device. It limits the pressure that can be exerted on the tanks (within the maximum allowable limits) when maximum pump capacity is discharged overboard. This would be the condition when the delivery of gasoline is stopped and the seawater pump continues to operate. However, the height of the loop and the expansion tank also maintains an adequate back pressure on the tanks to force gasoline to the suction side of the gasoline pumps. This ensures a positive pressure (0.5 to 1 psi) is maintained when maximum delivery of gasoline is being made. A one-way check valve and a shutoff valve are installed near the end of the overflow line. The shutoff valve is normally LOCKED OPEN. Steam-heating coils are installed around the overflow line at the shell connection to keep the line clear during icing conditions.

A vent line extends from the top of the loop to the atmosphere at the 02 level. The vent line is provided to break the syphoning effect of the overflow loop to prevent lowering the pressure at the gasoline pump suction header. This line also may be equipped with steam-heating coils.

OPERATION OF THE SEAWATER SYSTEM

The seawater system serves to force the gasoline through the tank and up to the gasoline pump suction. A pressure of about 0.5 to 1 psi is required at the gasoline pump suction to prevent the gasoline pumps from becoming vapor locked.

The seawater pump should be put into operation before starting up the gasoline pump. The seawater pump will discharge to the outer tank. As gasoline is drawn from the tank, it is automatically replaced with seawater, thus maintaining a positive pressure on the gasoline pump suctions. Excess seawater will automatically be discharged overboard through the over-flow line.

1. To line up the system to take suction from the sea and to discharge to the outer tank supply riser, take the following actions:

a. Open the shutoff valve between the sea chest supply riser and the pump suction header.

b. Open the shutoff valve between the pump discharge header and the outer tank supply riser.

2. To align the seawater pump, take the following actions:

a. Open the shutoff valve in the pump suction line.

b. Vent the pump through a petcock at the top of the pump casing. When seawater appears, close the petcock.

c. Start the pump with the discharge valve closed. When the pump discharge pressure builds up, open the discharge valve SLOWLY.

DOUBLE-WALLED GASOLINE PIPING

When MOGAS passes through spaces, it is carried in double-walled piping that consists of two concentric pipes (fig. 6-11). The inner pipe is copper

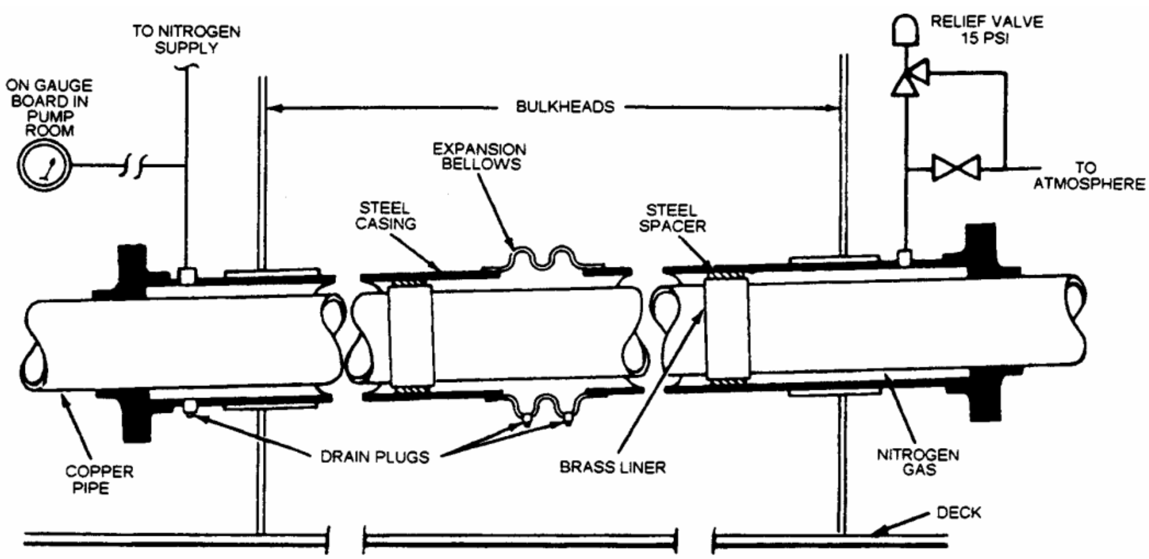


Figure 6-11.—Double-walled piping.

nickel and carries the fuel. The outer pipe is steel and serves as an armor casing. The outer pipe also serves to contain a protective jacket of inert nitrogen gas at 3 psi around the inner piping. A pressure gage for the double-walled piping is installed in the pump room to indicate the pressure in the piping. The gage has a range of zero to 15 psi.

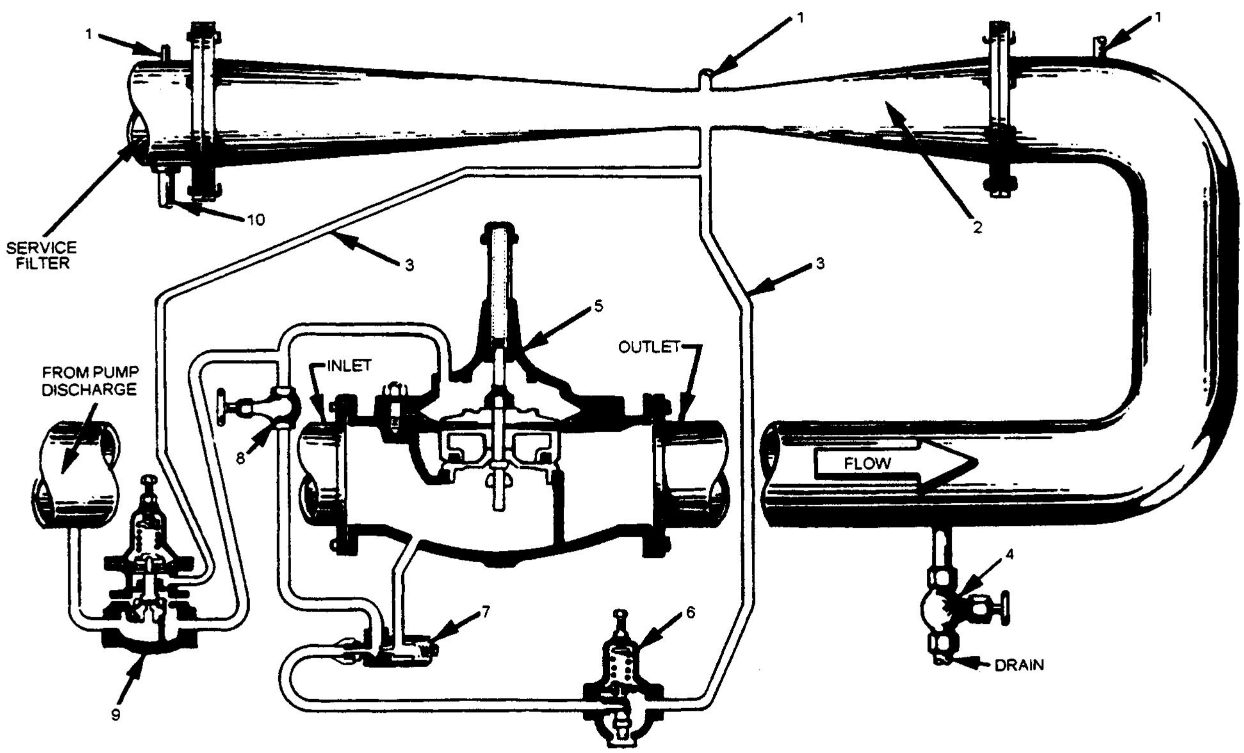
If the outer casing is pierced, the nitrogen gas will leak out. The resulting drop in pressure will be indicated on the gage. Also, if a rupture should occur in the fuel line inside the steel casing, the resulting increase in pressure will be indicated on the gage. Isolate the piping until the cause has been determined.

Expansion bellows are provided in the outer casing to avoid strains in the casing due to unequal expansion, which may result in leakage of the nitrogen gas. Drain plugs in the bellows can be used to determine whether any leaks have occurred in the inner piping. Brass liners soldered to the outside of the inner piping and steel spacers welded to the inside of the outer piping are placed at intervals of about 5 feet. These serve to hold the inner piping in the center of the outer piping and still allow for movement caused by expansion and contraction between the two pipes. The outside piping is about 2 inches larger than the inner piping.

An inert gas connection, for charging the outer piping, is provided at the lower or inboard end of the double-walled piping. The outer piping is also provided with a relief valve to avoid excess pressure. The released inert gas is vented to the atmosphere through separate piping. The relief valve is set at 15 psi.

AUTOMATIC PRESSURE-REGULATING SYSTEM

The pressure-regulating system (fig. 6-12) used in MOGAS risers is identical for all class ships except for size and pressure settings. This section deals with a typical regulating system without reference to size



1. Gage lines
2. Venturi
3. Actuating lines
4. Drain valve
5. Hytrol valve
6. Pilot valve
7. Ejector-strainer
8. Globe valve
9. Control valve
10. Recirculating line

Figure 6-12.—MOGAS pressure-regulating system.

or pressure. On LHAs, the pressure regulator is typically installed after the filter. On other class ships, it may be installed before the filter.

An automatic pressure-regulating system is provided in all MOGAS distribution risers.

The pressure regulator consists of an automatic pressure-regulating valve operated through changes of pressure in the throat of a venturi, located downstream of the valve. The main components of the system (fig. 6-12) are as follows:

- Main valve (pressure regulator) (5)
- Pilot valve (6)
- Ejector strainer assembly (7)
- Control valve (9)
- Venturi tube (2)

NOTE

Venturi Principle. If a fluid flowing through a tube reaches a constriction or narrowing of the tube, the speed of the fluid flowing through the constriction increases and its pressure decreases. If the fluid flows beyond the constriction into a tube the same size as that of the original, the speed of flow decreases and the pressure increases.

The pressure-regulating system is entirely hydraulic in operation, using line pressure to open and close the valve. Because of this, it can be installed either vertically or horizontally in the riser.

The main valve is of a modified globe design, employing a well-supported and reinforced diaphragm. When line pressure is admitted to the cover chamber, the valve tends to close. When pressure is reduced in the cover chamber, line pressure under the disk opens the valve.

The pilot valve is a direct-acting, spring-loaded valve designed with a large diaphragm and effective working area to ensure sensitive control and accurate regulation of the required delivery pressure. The pilot valve is located in the actuating line between the ejector strainer and the venturi throat. It is normally held open by a compression spring. When venturi throat pressure acting under the diaphragm increases, the valve tends to close. When venturi throat pressure decreases, the valve opens (wider). Thus, a constant pressure is maintained by balancing venturi throat pressure against spring tension.

The ejector strainer assembly is installed in the actuating line between the main valve and the pilot valve. It consists of an ejector nozzle with a 1/16-inch orifice protected by a 60-mesh monel strainer to prevent clogging of the nozzle. The assembly speeds up the operation of the main valve by speeding up the evacuation of fluid from the cover chamber. It prevents chatter of the main valve by reducing the violence with which pump discharge pressure is admitted to the main valve cover chamber.

The control valve is a direct-acting, spring-loaded valve designed with a large diaphragm and effective working area to ensure positive operation. The control valve, located in the ejector bypass line, is normally held closed by a compression spring. Its purpose is to close the main valve quickly when there is a sudden buildup in downstream pressure. It is opened by venturi throat pressure 10 psi in excess of the pilot valve setting.

Venturi tubes are installed in the distribution riser downstream of the regulating valve. The venturi tapers from a 2-inch inlet to a 3/8-inch throat to a 2-inch outlet. A recirculating line on the delivery side normally returns 5% of the capacity of the booster pump.

Operation of the Automatic Pressure Regulator

In the operation of the system, high-pressure fuel flows initially from the pump and enters the main valve body. This fuel bypasses the main valve seat and flows through the ejector strainer assembly to the pilot valve. The pilot valve is held open by its spring. From the pilot valve, this flow is directed into the throat of the venturi tube. At this point, the pressure at the throat of the venturi tube is practically nonexistent.

As long as the pilot valve stays open, maximum flow through the ejector strainer assembly is permitted. This flow through the ejector strainer assembly creates a reduced pressure in the main valve cover chamber. (Remember that the ejector strainer assembly works like an eductor.) Line pressure from the pump, working under the disk of the main valve, can now open the main valve, permitting flow into the distribution riser. This flow builds up pressure in the distribution riser.

The increasing pressure in the riser is transmitted from the throat of the venturi tube to the underside of the pilot valve diaphragm. When the pressure under the pilot valve diaphragm reaches a point where it is greater than the setting of the pilot valve spring, the pilot valve begins to close. This restricts the flow through the ejector strainer assembly. When this flow is restricted, the ejector strainer assembly loses its suction and the inlet pressure is diverted, by way of the suction line, to the main valve cover chamber.

The resultant increase in pressure in the main valve cover chamber, as applied to its diaphragm, is sufficient to begin closing the main valve. The main valve disk will move toward its seat until the main valve is passing just enough fuel to maintain pressure that will balance the setting of the pilot valve through the throat of the venturi.

Any later change in fuel demand will cause a change in venturi throat pressure. Even the slightest change is enough to cause the pilot valve and the main valve to assume new positions to supply the new demand. This will happen regardless of whether the demand is for a greater or lesser amount of fuel.

TOPSIDE INCREASE OF FLOW DEMAND. —An increase in the rate of flow will first cause a momentary decrease in venturi throat pressure. This decrease in pressure will allow the pilot valve to open wider, which, in turn, increases the flow rate through the ejector strainer assembly.

An increase in the ejector strainer assembly flow rate will increase the suction lift of the ejector. The increase of the suction lift is applied to the main valve cover chamber and allows the main valve to open wider.

The main valve will open in proportion to the increase of flow demand topside. The main valve will continue to open until the venturi throat pressure builds up to a point where it again balances the setting of the pilot valve spring.

TOPSIDE DECREASE OF FLOW DEMAND. —A decrease in flow rate will cause a momentary increase in venturi throat pressure. This increase in pressure will cause the pilot valve to close somewhat, restricting the flow through the ejector strainer assembly.

A decrease in flow through the ejector strainer assembly will decrease the suction lift of the ejector. This decrease of ejector suction lift will cause an increase of pressure in the main valve cover chamber and result in partial closing of the main valve.

The main valve will close in proportion to the decrease of flow demand topside. The main valve will continue to close until the venturi throat pressure drops to a point where it again balances the setting of the pilot valve spring.

SUDDEN DEMAND DECREASE. —Any sudden decrease in flow rate will create a sudden, high increase in venturi throat pressure. This sudden increase of pressure will be applied to the underside of the diaphragm of the pilot valve to close the main valve in the normal manner. Because of the small size of the orifice in the ejector strainer assembly (1/16-inch diameter), the main valve will close slowly. Venturi throat pressure will, at the same time, be applied to the underside of the diaphragm of the control valve to open the control valve. When the control valve opens, full pump discharge pressure is applied to the main valve cover chamber to quickly close the main valve. This quick closing of the main valve reduces the pressure in the distribution riser. The main valve remains closed until the pressure on the discharge side of the main valve drops below the spring setting of the pilot valve. The pressure and fuel that are trapped between the discharge side of the main valve and the discharge side of the venturi, caused by a sudden buildup of discharge pressure, are relieved through the venturi recirculating line back to the draw-off tank.

Adjustment and Settings

The pilot valve pressure adjustment is made by turning the adjusting screw to vary spring compression on the diaphragm. The control valve adjustment is made by turning the adjusting screw clockwise to increase the pressure. The procedure for adjusting the pressure setting follow:

NOTE

> The following procedure should be carried out after reinstallation of the regulating valve and pilot assembly and after the maintenance check has been performed. The typical desired delivery pressure is 22 psi at the throat of the venturi.

1. Close the control valve by turning the adjusting screw clockwise.

2. Set the pilot valve at 34 psi when fuel is flowing through the main valve at 50 gpm or more.

3. Reduce the pressure setting of the control valve (by turning the adjusting screw counterclockwise) until delivery pressure drops to 32 psi at the throat of the venturi.

4. Tighten the control valve locknut.

5. Reset the pilot valve at 22 psi.

The procedure outlined above will establish the desired downstream pressure and provide the correct setting of the control valve.

Maintenance

The ejector strainer assembly should be cleaned at regular intervals in accordance with PMS requirements. Remove the 3/4-inch union ring and plug from the housing, wash in solvent, and then blow the screen out with air. At 6-month intervals, the regulating valve should be completely dismantled and thoroughly cleaned. The pilot valve and control valve should be inspected carefully for excessive wear, and, if necessary, replaced. All gages used in the pressure-regulating valve system are removed, cleaned, and calibrated every 12 months. Upon installation of new parts or repairs made on parts, all piping connections are pressure tested to check for leakage of fuel.

MOGAS PUMPS

The MOGAS pumps on LPHs are centrifugal pumps with a rated capacity of 50 gpm at 90 psi. MOGAS pumps are typically called transfer pumps. See chapter 4 for information of centrifugal pumps.

SYLPHON PACKLESS GLOBE VALVE

The Sylphon packless globe valve (fig. 6-13) is used to stop the hazardous leakage of gasoline past the

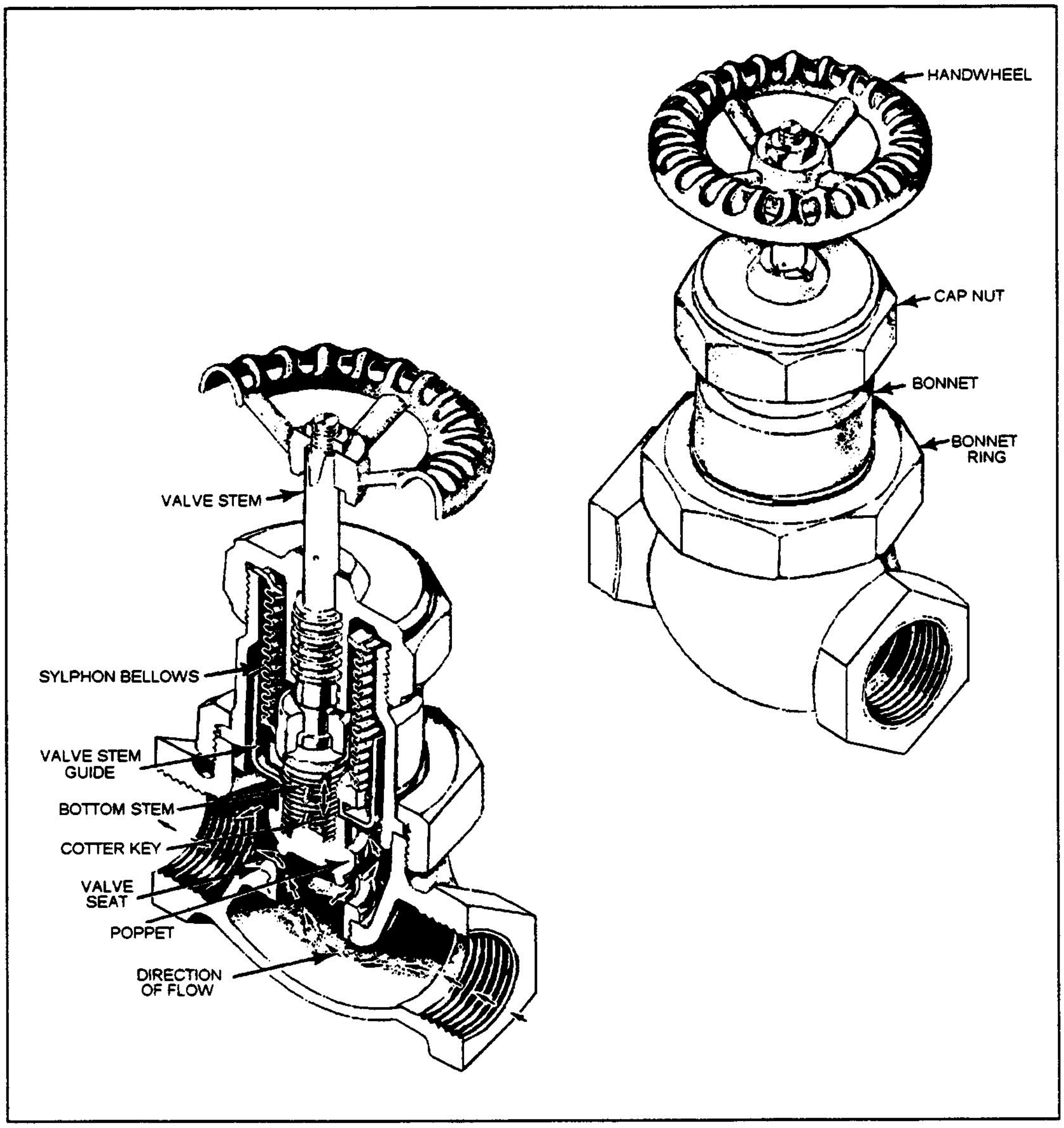


Figure 6-13.—Sylphon packless globe valve.

packing in the ordinary valve by providing a metal bellows (Sylphon), which prevents liquid from escaping through the valve stem opening.

Sylphon packless globe valves are used in the pump room on the drainage piping from the centrifugal pumps, on other small-diameter pipelines carrying gasoline or nitrogen, and on steaming-out connections.

The Sylphon packless globe valve controls the flow of liquid the same way as an ordinary globe stop valve. When the control handle is turned, a poppet at the end of the valve stem is lifted from a valve seat and permits flow through the valve. It has an expandable, metal bellows (or Sylphon) assembled between the valve poppet and the bonnet cap nut. This permits the valve stem to be raised or lowered while maintaining a complete seal around the stem at all times. In the ordinary globe valve, a fiber packing is used to prevent the escape of liquid. This packing deteriorates or shrinks and allows dangerous leakage of liquid or vapor. The Sylphon bellows may be replaced if it corrodes or breaks.

PROTECTIVE SYSTEM

Nitrogen (N_2) or carbon dioxide (CO_2) is used in cofferdams as a protection against fire and explosion, in double-walled piping to indicate the condition of the double-walled piping, and in the distribution piping for drainback, purge, and charge.

On LHAs, nitrogen was capable of being produced aboard the ship, but most of the production plants are no longer operable. Instead, it must be earned in 3000 lb bottles. Other class ships also must carry N_2 and/or CO_2 in compressed-gas bottles and the inerting process is slightly different. Consult CFOSS for the correct procedures on your ship.

Nitrogen enters the pumproom reducer at 50 psi from the nitrogen supply room. To purge and inert the MOGAS piping, the reducer is bypassed and the piping is charged directly from the nitrogen supply line. The gages must be monitored to make sure the pressure does not exceed 10 psi. The MOGAS piping is required to be inerted with a 50% N_2 inert gas concentration at 10 psi.

The reducer is used to reduce the N_2 pressure from 50 psi to 3 psi for inerting the double-walled piping, the cofferdam, and the gasoline tank (after deballasting). The double-walled piping, cofferdam, and gasoline tank (when deballasted) are required to be made inert with a 50% inert gas concentration at 3 psi.

The pressure relief valve for the piping/double-walled piping is set at 14 psi. The pressure relief valve for the cofferdam is set at 7 psi.

NOTE

Ships using carbon dioxide in place of nitrogen purge to 35% inertness minimum.

INERT-GAS-PRESSURE REGULATING VALVE

The inert gas regulating valve consists of a dome and body separated by a rubberized diaphragm. The diaphragm actuates The poppet valve in the valve body by forcing down the valve stem. A compression spring below the poppet valve tends to return the valve to its seat against the force of the diaphragm. The dome is filled with inert gas under pressure when the valve is adjusted. This gas pressure acts on the upper surface of the diaphragm. A pressure chamber on the underside of the diaphragm fills with nitrogen through an opening to the discharge, or low pressure, side of the valve. Thus, when the valve has been adjusted and is in operation, the pressure on the upper side of the diaphragm acts to force the valve open. This force is balanced by the low-pressure gas on the underside of the diaphragm and the spring under the poppet valve. When low-pressure gas is taken from the system, the pressure on the discharge side starts to fall, and the regulating valve opens to permit passage of gas from the high-pressure side of the valve. The distance the valve opens depends on how fast the low-pressure gas is being used. When use of low-pressure gas is stopped, the pressure on the underside of the diaphragm starts to increase, and the valve closes to stop the flow of high-pressure gas.

When the regulating valve is being adjusted, nitrogen gas from the high-pressure side of the valve is admitted to the dome chamber through an orifice controlled by two needle valves (fig. 6-14). A ball relief valve to the orifice will release gas if the high--pressure needle valve in the body is opened too far.

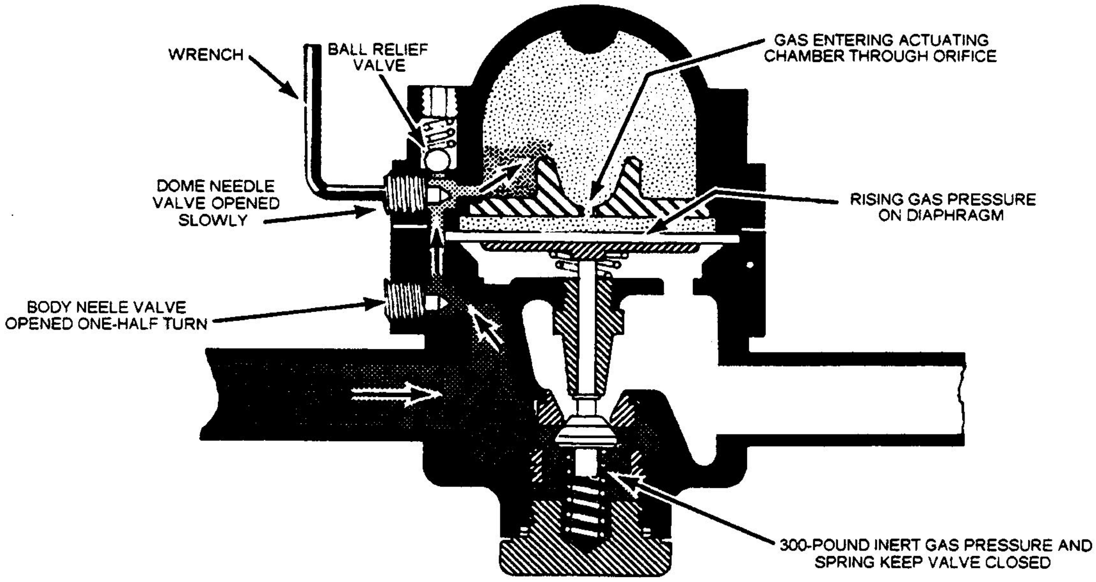


Figure 6-14.—Adjusting the inert-gas-pressure regulating valve.

To put the reducing valve in operation, use the following procedure:

1. Close the valve body needle valve and dome needle valve.

2. Close the stop valve on the low-pressure side. Open the inlet valve on the high-pressure side and open the low-pressure gage valve.

3. Open the body needle valve one-half turn to permit gas to flow into the loading channel.

4. Open the dome needle valve slowly. This permits gas to flow into the dome. Gas entering the dome flows through the orifice in the dome plate and acts on top of the diaphragm.

5. The increasing gas pressure forces the diaphragm down and slowly opens the valve. Gas then flows through the valve opening into the low-pressure side of the valve and into the lower pressure chamber, There, the increasing pressure of the gas acts on the underside of the diaphragm, pushing it up to close the valve (fig. 6-15). When the low-pressure gages register the desired pressure, take the following actions:

a. Close the dome needle valve.

b. Close the body needle valve.

The valve is now adjusted and ready for use. Figure 6-16 shows the pressure-regulating valve in operation.

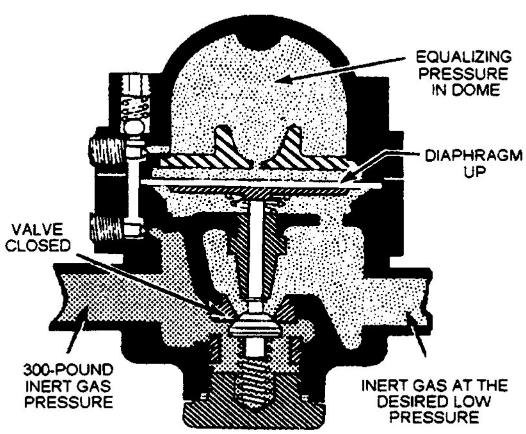


Figure 6-15.—Inert gas system balanced, valve closed.

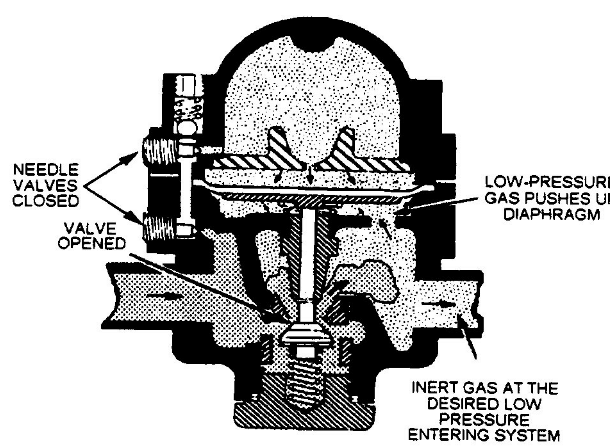


Figure 6-16.—Valve in operation.

PORTABLE INERTNESS ANALYZER

The inertness analyzer (fig. 6-17) is a portable, electrical instrument used to indicate the presence of inert gas and combustible vapors in the atmosphere in voids surrounding the gasoline storage tanks and double-wall piping when the service system is being purged.

Components and Functions

The instrument is contained in a case with a carrying handle. On the front of the box are the controls and indicating dial. An ON-OFF switch controls electrical power to the analyzer. A milliammeter indicates the analyzer current in milliamps. The galvanometers indicates presence of inert gas in percentage of inertness.

The unit has three potentiometers: the current potentiometer that is used to set the analyzer current to 150 milliamps: the sensitivity potentiometer that is used to calibrate the analyzer: and the zero potentiometer that is used to make a final adjustment to zero the galvanometer, if necessary.

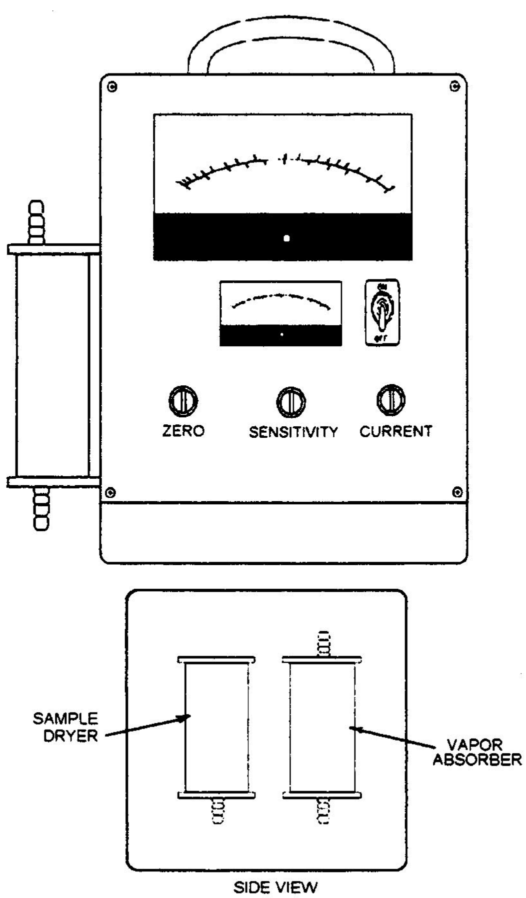


Figure 6-17.—Portable inertness analyzer.

A sample dryer (which has only a bottom hose connection) is filled with calcium chloride that absorbs moisture from the sample, and a vapor absorber (which has upper and lower hose connections) is filled with activated carbon that absorbs fuel vapors from the sample. An aspirator bulb and hoses are used to pump samples through the analyzer. The unit is powered by two 6V dc batteries.

Operation

Before using the instrument to analyze an enclosure, the unit must be prepared in normal room air. The current must be adjusted, and the analyzer must be purged and zeroed.

To prepare the analyzer for use, turn the unit ON. adjust the current to 150 milliamps, and allow 2 minutes for the analyzer to reach operating temperature. Make sure the aspirator discharge is connected to the analyzer. Then use the following steps:

1. Connect the aspirator bulb and hoses to the inlet of the sample dryer.

2. Aspirate air through the analyzer until the galvanometers needle comes to rest.

3. If necessary, set the galvanometers needle to zero using the zero adjustment.

To analyze enclosures containing air and inert gas, use the following steps:

1. Connect the aspirator bulb and hose between the sampling outlet of the enclosure to be tested and the inlet of the sample dryer.

2. Operate the aspirator bulb until the galvanometers needle comes to rest.

3. Note the reading.

To analyze enclosures containing air, inert gas and fuel vapors, use the following steps:

1. Connect the aspirator bulb and hose between the sampling outlet of the enclosure to be tested and the inlet (bottom) of the vapor absorber.

2. Connect the jumper hose between the outlet (top) of the vapor absorber and the inlet of the sample dryer.

3. Operate the aspirator bulb until the galvanometers needle comes to rest.

4. Note the reading. If this reading is not the same as the reading when testing for only air and inert gas,

fuel vapors are present and *this reading* is *the correct percentage of inertness.*

Upon the completion of all analysis, turn the analyzer off and purge the vapor absorber in a normal room atmosphere. Connect the aspirator hose and bulb to the outlet (top) of the vapor absorber and operate the aspirator bulb for three minutes.

Maintenance

The batteries have a useful life of about 100 hours. When the current adjustment rheostat does not bring the indicating needle to 150 milliamps on the scale, the batteries should be replaced.

After every 50 analysis, examine the calcium chloride and replace it if it is glazed or hard. Also, the activated carbon should be reactivated or replaced after every 50 analysis. As with all equipment maintenance, refer to the technical manual and MRCs for the correct procedures.

CO_2 FLOODING SYSTEM

Carbon dioxide is stored in steel cylinders at pressures from 700 to 1,000 psi, depending on variations in temperature. At these pressures, about two-thirds of the cylinder's contents is in liquid form. As gas is released through the opened cylinder valve, the pressure is gradually lowered until all the CO_2 turns into gas. Thus, the contents of CO_2 in the cylinder will expand about 450 to 500 times in volume when it is released. When fully charged, the large-size cylinders contain 50 pounds of CO_2.

Carbon dioxide is used for the protection of, and firefighting in, the gasoline pump room, motor room, access trunk, and fuel filter rooms, Carbon-dioxide cylinders are located in motor rooms and in compartments on the second deck directly above the filter rooms. The CO_2 release valves on the cylinder are operated by a cable, with cable pull boxes located at three places. The cylinder valves are thus opened, but they cannot be closed. Spare CO_2 cylinders are carried aboard.

The CO_2 emergency fire-extinguishing system for fuel pump rooms, motor rooms, access trunks, and filter rooms is similar on all ships.

Carbon-dioxide cylinders, located inside each of the motor rooms, are connected by piping to the fuel pump room, motor room, and access trunks. The other four are spares. The cylinders release carbon dioxide into the piping when operated by any of the pull boxes. A pull box is located inside the fifth-deck access trunk, the fire-pumproom and on the starboard side of the hangar deck across from the MOGAS-pumproom access.

The emergency pull box is watertight and has a metal cover with a rubber gasket held by friction clutches on the rim. Under the cover is a glass plate labeled with instructions for using the pull box. Also under the glass plate is a pull handle connected through a cable and pulley to a cylinder valve on the carbon dioxide cylinder head. To operate the pull box, release the friction catch to allow the cover plate to drop, break the glass and pull out the handle until the red portion of the pull cable can be seen. *After a 15-second delay,* released carbon dioxide gas flows through the piping to the fuel spaces, where it is discharged through diffusing horns and spreads as a smothering blanket, eventually filling the compartment.

Connections from the carbon dioxide-cylinder distribution lines allow carbon dioxide to operate two pressure switches. Pressure from the carbon dioxide throws electric switches to actuate a carbon-dioxide warning bell in the space, a visual alarm outside the space at the access, and to stop the exhaust ventilation system fan motors. Stoppage of the ventilation system will cause operation of an audible and visible alarm.

RECEIVING GASOLINE ABOARD

When gasoline is to be taken aboard, there are certain preparations to be made. First, establish the amount of gasoline to be received. The maximum allowable capacity required onboard will be 95% at sea or at anchor and 80% when the ship is alongside a pier. Gasoline is received aboard ship through the starboard main deck filling connections.

Equipment required at the filling connection is as follows:

- Swabs
- Rubber bucket
- Empty 5-gallon safety can
- Tool box with non-sparking tools
- Sample bottles
- Ground wire
- A portable funnel and a portable 2 1/2-inch hose connection

- Buns-N-Cork gaskets for the filling connection.

Sound-powered-phone headsets are required to establish communications between the following locations:

Filling connection

Gasoline pumproom

Venting station

Overboard discharge station

Fire-fighting stations must be manned and have equipment on hand as specified by the ship's refueling bill.

When receiving MOGAS aboard, it is mandatory to keep a refueling log. This receiving log will contain the following information:

1. Date and source received from
2. Time pumping started
3. Time pumping stopped
4. Meter reading before starting (truck only)
5. Meter reading after stopping (truck only)
6. Liquid level reading before starting
7. Liquid level reading after stopping
8. Rate of flow received
9. Average tank top pressure during operation
10. Maximum tank top pressure during operation
11. Amount received
12. Amount charged
13. Difference between 11 and 12
14. Any discrepancies that occur during the receiving operation
15. Condition of samples

The receiving operation can be accomplished in port by mobile tankers, barges, or drums. Regardless of the source of receiving, the operating steps are basically the same. Only the time required will be different.

Connect the portable 2 1/2-inch hose connector to the filling connection. Make sure the cofferdam is charged with N_2 to 50% inertness at 3 psi. Make sure the CO_2 fire extinguishing system is on, operating properly, and ready for immediate operation.

Look in the sight glass in the MOGAS tank fill line to check for the presence of seawater. If no seawater is present, open the tank top valve and introduce seawater into the tank with the seawater compensating pump until liquid is observed in the sight glass.

After all preparations are made, align the piping systems as follows:

Seawater compensation system alignment

1. Make sure the following valves are closed:
   a. Steam-out hose connection valve
   b. Seawater compensating pump valve
2. Make sure the following valves are locked open:
   a. Seawater elevated loop overboard discharge valve
   b. Seawater equalizing tank valve
   c. Seawater supply valve to the MOGAS tank

The seawater system is aligned in the following manner to allow the seawater in the MOGAS tank to be pushed out via the overboard discharge as MOGAS is pumped into the tank:

Gasoline distribution system alignment

1. Make sure the following valves are closed:
   a. Portable Inertness Analyzer (PIA) test connection valve
   b. Filter drain to MOGAS draw-off tank
   c. Venturi outlet valve
   d. Tanktop valve
   e. Vehicle fueling station isolation valve
   f. Flow meter bypass valve
2. Make sure the following valves are open:
   a. Vehicle fueling/filling station isolation valve
   b. Flow meter inlet valve
   c. Flow meter outlet valve
   d. Filling line isolation valve

Vent the distribution system as follows:

1. Align the piping to vent from the tank through the filter.

2. Open the filling valve SLOWLY at the filling station.

At this time, the distribution piping is filled with N_2 gas, which is vented to the atmosphere, and the piping filled with MOGAS prior to opening the tank-top.

3. Vent into a 5-gallon safety can.

CAUTION

Stand clear of the nozzle when venting inert gas into the atmosphere.

4. Align MOGAS piping for venting IAW CFOSS.

5. Monitor transfer pump discharge line pressure and report when inert gas (N_2) pressure is 0 psi.

6. Close the transfer pump discharge and suction valves, filter outlet and inlet valves, and venturi discharge. Report the MOGAS system is aligned for filling the MOGAS tank.

To replenish the MOGAS system, follow these procedures:

1. Before connecting the hose from the refueling source, first ground the refueling source to the deck, then to the filling connection.

2. Couple the fueling hose to the 2 1/2-inch connection and open the filling connection valve.

3. Set the flowmeter to 0 gallon.

4. Open the tanktop valve and tell the refueling source to start pumping at a low rate.

CAUTION

The pumproom operator must constantly monitor tanktop pressure when filling the tank. Do NOT exceed rated tanktop pressure (normally, 23 psi is the maximum). Throttle the filling isolation valve as necessary to maintain acceptable pressure.

5. Take a sample at the receiving station and inspect the system for leaks. If the gasoline is good and there are no leaks, increase the pumping rate.

NOTE

As soon as seawater is observed discharging from the overboard discharge, notify the pumproom operator.

6. When the tanks are approximately 75% full with MOGAS (to allow sufficient room to drain back the MOGAS distribution piping), do the following:

a. Order the refueling source to stop pumping.

b. After pumping has stopped, close the vehicle fueling/filling station isolation valve.

c. Close the tanktop valve.

To align the MOGAS system for draining, purging, and making inert after receiving, use the following procedure:

1. Make sure the following valves are closed:

a. Filling station/transfer valve.

b. Tanktop valve.

2. Make sure the following valves are open:

a. MOGAS filling line isolation valve.

b. Flow meter inlet valve.

c. Flow meter outlet valve.

d. Vehicle fueling/filling station isolation valve.

e. Flow meter bypass valve.

3. Observe the fill line sight glass to determine the liquid level in the piping. Open the MOGAS tanktop valve.

4. Open the air operated N_2 inert gas supply valve.

5. When the liquid level in the fill line sight glass disappears, close the MOGAS tanktop valve.

CAUTION

The tanktop valve must be closed immediately when the liquid level drops below the sight glass, to prevent N_2 inert gas from entering the draw-off tank.

6. Close the air-operated N_2 inert gas supply valve.

Report that the MOGAS piping is drained and the piping is now being purged. To purge the piping, use the following procedures:

1. Make sure the following valves are open:

a. Filter bypass valve.

b. Venturi outlet valve.

c. Transfer pumps blowback valve.

d. Transfer pumps pressure gage cutout valves.

2. Crack open the N_2 inert gas valve. The filling station will monitor and determine when the piping is inerted to a 50% inert gas concentration.

3. When ordered, charge piping to 10 psi by observing pump discharge line pressure gages. When the gages indicate 10 psi, close the N_2 inert gas valve.

4. Secure all distribution piping valves IAW CFOSS.

STRIPPING THE MOGAS TANKS

As stated earlier, there are two stripping systems installed in the MOGAS tank. They are the hand-operated and the motor-driven systems.

Hand Stripping Procedures

To hand strip the MOGAS tank with the hand-stripping pump, use the following procedures:

1. Make sure the following valves are closed:

a. Motor-driven stripping pump suction and discharge.

b. Isolation valves to and from the MOGAS service system.

c. Portable eductor hose hookup to the overboard discharge.

2. Open the following valves:

a. Hand-stripping pump suction valve.

b. The designated tank valve (drawoff or outer).

c. The designated valve for receiving the pump discharge (overboard or outer tank).

3. Report that the hand-stripping pump is aligned.

4. Operate the hand-stripping pump and strip until an acceptable sample is obtained or the tank is empty (based on the purpose for stripping).

5. Report that stripping is complete.

6. Close the following valves:

a. Designated tank suction valve.

b. Designated discharge valve.

c. Stripping pump suction valve.

7. Report that stripping alignment is secured.

Motor-Driven Stripping Procedures

The motor-driven stripping system is typical] y used to deballast the MOGAS tank. To deballast the MOGAS tank, use the following procedure:

1. Vent the tank to the atmosphere prior to deballasting.

2. Make sure the following valves are closed:

a. MOGAS transfer pump suction isolation valve.

b. MOGAS transfer pump discharge isolation valve.

c. Stripping pump test connection valve.

d. Eductor overboard discharge connection.

e. Hand-stripping pump overboard discharge valve.

f. Stripping pump isolation valve.

3. Open the following valves:

a. Overboard discharge line.

b. Stripping pump suction and discharge valves.

4. Report valve alignment complete.

5. To deballast the draw-off tank:

a. Open the draw-off tank stripping valve.

b. Start the stripping pump.

c. Observe the sight glass and when no liquid is visible, stop the pump.

d. Close the draw-off tank stripping valve.

6. To deballast the outer tank:

a. Open the outer tank stripping valve.

b. Start the pump.

c. Observe the sight glass and when no liquid is visible, stop the pump.

d. Close the outer tank stripping valve.

7. To secure from deballasting:

a. Make sure the outer tank stripping valve is closed.

b. Make sure the drawoff tank stripping valve is closed.

c. Close the stripping pump suction and discharge valves.

d. Close the overboard discharge valve

8. Report deballasting secured.

9. Inert the MOGAS piping to 50% inertness with nitrogen at 10 psi.

MOGAS SERVICING AND SECURING OPERATIONS

As with receiving gasoline aboard, there are specific procedures to be followed to ensure safe and efficient servicing with MOGAS.

The first step is to vent the system to the atmosphere. Follow the following procedures:

1. Make sure the following valves are closed:

   a. MOGAS fill isolation valve.

   b. PIA test connection valves.

   c. N_2 inerting supply valves.

   d. Flow meter and filter bypass valves.

   e. Stripping pump suction and discharge.

   f. Steam-out connections.

2. Open the following valves:

   a. Vehicle fueling station cutout valves.

   b. Flow meter inlet and outlet valves.

   c. Filter inlet and discharge valves.

   d. Filter pressure gage cutout valves.

   e. Transfer pump suction and discharge valves.

   f. Transfer pump gage cutout valves.

3. Set the flow meter to 0.

4. Report that the piping is aligned for venting inert gas.

5. Monitor transfer pump discharge line pressure and report when inert gas pressure is 0.

6. Vent into a 5-gallon safety can.

CAUTION

Stand clear of the nozzle when venting inert gas into the atmosphere.

7. Secure the following valves when venting is complete:

   a. Transfer pump suction and discharge valves.

   b. Filter inlet and outlet valves.

To align the MOGAS system for transferring MOGAS to vehicles, use the following procedures:

Sea Water Compensation System

1. Make sure the following valves are opened:

   a. Seawater elevated loop overboard discharge valve (must be locked open).

   b. Seawater supply valve to the tank (must be locked open).

   c. Seawater sea chest valve.

   d. Sea water equalizing tank valve.

   e. Seawater compensating pump discharge valve.

2. Report that the seawater compensating system is aligned.

3. Start the seawater compensating pump.

Transfer Pump Alignment

1. Open the following:

   a. Transfer pump recirculating valves.

   b. Recirculating valve to drawoff tank.

   c. Draw-off tanktop valve.

   d. Designated transfer pump suction valve.

   e. Venturi recirculation valve.

2. Start the pump.

CAUTION

Do NOT operate the transfer pump when the thermometer in the discharge header exceeds 100°F.

3. Report that the pump is started and recirculating.

4. SLOWLY open the pump discharge valve.

Filter Alignment (Do NOT vent the filter overboard in port.)

1. Open the following:

   a. Filter gage cutout valves.

   b. Filter vent valve.

c. Inlet valve (SLOWLY).

d. Drain valves to the drain tank.

2. When MOGAS appears at the filter vent sight glass, close the vent valve and slowly open the filter discharge.

3. Report that the filter is vented and the discharge open.

Fuel vehicles in accordance with CFOSS and your command's instructions. Always ensure that qualified supervisors are on station.

To secure from fueling:

1. Secure the station IAW CFOSS.

2. Secure the transfer pump:

a. Stop the pump.

b. Secure the tanktop valve.

c. Close the inlet and discharge valve.

d. Close the suction and discharge pressure cutout valves.

e. Close the recirculating line valves.

3. Drain back the piping:

a. Close the automatic filter drain valve.

b. Close the drain tank valve.

c. Open the following valves:

(1) Fueling station/fill station isolation valve.

(2) Fill line isolation valve.

(3) Tanktop valve.

(4) Flow meter bypass valve.

(5) Transfer pump blow back valves.

(6) Filter drain valve and drain valve to the draw-off.

d. Ensure the following is opened:

(1) Filter inlet and bypass.

(2) Transfer pump discharge valves.

(3) Venturi discharge valve.

(4) Flow meter inlet and discharge valves.

(5) Transfer pump recirculating valves.

(6) Draw-off tanktop valve.

(7) Draw-off recirculating tanktop valve.

e. Open the air-operated N2 inert gas supply valve located on the second deck.

f. Observe the reflex sight glass gage. When liquid is no longer visible, close the following:

(1) Tanktop valve.

(2) Draw-off tanktop valve.

(3) Draw-off recirculating valve.

(4) Air-operated N_2 inert gas supply valve.

g. Report that the piping is drained.

4. Purging the MOGAS system.

a. Open the following valves:

(1) Drain tank vent valve.

(2) Drain tank valve.

(3) Filter vent valve.

(4) Crack open the N_2 inert gas supply in the pump room.

b. Monitor inertness at the filling station.

c. Purge until 50% inertness is attained.

5. Inerting (charging the piping).

a. Monitor the transfer pump and filter discharge gages.

b. Close the N_2 inert gas supply valve in the pumproom when 10 psi is reached.

c. Report 10 psi on the piping.

6. Secure by closing the following valves:

a. Filter vent.

b. Fill line isolation valve.

c. Flow meter inlet, outlet, and bypass valves.

d. Transfer pump blow back, inlet, and discharge valves.

e. Filter inlet, outlet, and bypass valves.

f. Filter drain valves.

g. Venturi discharge.

h. Fueling station/fill station isolation valve.

GAS-FREEING THE MOGAS SYSTEM

All gasoline tanks, voids, and piping must be certified "Safe For Men/Safe For Hot Work" by the Gas Free Engineer before any work is done on the system. After off-loading of gasoline, the tanks are flushed with seawater to rid the tanks of traces of liquid gasoline. Three complete changes of seawater are required to ensure proper flushing.

To flush the tanks, use the following procedures:

1. Strip the outer and draw-off tanks as described in the earlier section for stripping procedures.

2. Make sure the following valves are closed:

a. Tank seawater supply line steam-out valve.

b. Sea chest steam-out valve.

3. Open the following valves:

a. Seawater elevated loop overboard discharge valve.

b. Seawater equalizing tank valve.

c. MOGAS tank seawater supply valve.

d. Seawater sea chest valve.

4. Start the seawater compensating pump, then open the discharge valve to fill the tanks with seawater.

5. When seawater is visible in the sight glass in the fill line, close the tanktop valve.

6. Stop the seawater compensating pump when the equalizing tank is full:

a. Close the discharge valve.

b. Close and lock the sea chest valve.

7. Complete the deballasting and filling evolution three times.

8. Report that flushing is complete.

After the tanks are emptied of all seawater, they are steamed to get rid of all traces of gasoline vapor. The tanks are coated with a zinc base that is not damaged by steam.

The procedures for steaming the tanks are as follows:

1. Close all valves in the system.

2. Connect a steam hose to the steam-out connection in the seawater supply line.

3. Open the following:

a. Tanktop fill valve.

b. Fill line isolation valve.

c. Flow meter bypass.

d. Filling station isolation valve.

NOTE

The system will be vented overboard from the most remote fueling station.

4. Remove the hose from the reel at the fuel station.

5. Commence steaming:

a. Steam the tank for 6 to 12 hours.

b. The temperature must not exceed 240°F.

c. Low-pressure air is injected with the steam to control the temperature and assist in forcing the steam through the piping.

6. Test the steam exhaust. (This is done by the Gas Free Engineer, using a Combustible Gas Indicator.)

7. When a negative reading is obtained, secure the steam and allow the tank and piping to cool.

8. Remove a positive stop valve close to the steam-out connection and check for damage.

The distribution piping must be steamed and gas freed for major maintenance such as welding, brazing, etc. Steam-out procedures for the distribution piping are as follows:

1. Connect a steam hose to the gasoline pump suction header steam-out connection.

2. Make sure the following valves are closed to prevent steam from entering the drawoff tank:

a. Tanktop valve.

b. Tanktop recirculating valve.

c. Tanktop drain line.

3. Replace the pressure regulator and a transfer pump with a spool. (This prevents damage to the seals and rotating element of the pump).

4. Open the valves in the distribution riser from the gasoline pump suction to the most remote fuel station:

a. Transfer pump inlet and discharge.

b. Filter bypass.

c. Venturi discharge.

d. Flow meter bypass.

e. Station isolation valve.

NOTE

Do not open the filter valves. The filter is steamed separately.

5. Remove the hose from the fuel station hose reel.

6. Commence steaming:

a. Steam the piping for 6 to 12 hours.

b. The temperature must not exceed 240°F.

c. Low-pressure air is injected with the steam to control the temperature and assist in forcing the steam through the piping.

d. Steam that condenses into water in the pump suction header may be stripped into the outer tank.

7. Test the steam exhaust. (This is done by the Gas Free Engineer, using a Combustible Gas Indicator.

8. When a negative reading is obtained, secure the steam and allow the piping to cool.

9. Remove appositive stop valve and check for damage.

The filter must be steamed prior to filter element removal/replacement and maintenance. To steam the filter, use the following procedures:

1. Remove the rotary control valve and install a blank flange and gasket on the sump.

2. Make sure the following valves are closed:

a. Filter inlet valve.

b. Filter drain valve.

c. Filter vent valve.

3. Open all valves from the filter discharge to the fill connection.

4. Connect an extension hose to the fill connection and lower it over the side to the water line.

5. Commence steaming:

a. Steam for 6 to 12 hours.

b. Do not exceed 15 psi.

c. Condensation that accumulates in the filter sump may be manually drained.

6. Test the steam exhaust. (This is done by the Gas Free Engineer, using a Combustible Gas Indicator).

7. Remove a positive stop valve and inspect for damage.

NOTE

At the end of steaming, check the tightness of all flange connections and inspect butterfly valves.

After the tanks have been steamed and maintenance completed, they must be refilled with seawater. Seawater will be taken on in deep water where the chance of picking up mud and silt from the bottom is remote.

To fill the tanks with seawater, use the following procedure:

1. Make sure the overboard discharge valve is locked open.

2. If icing conditions exist, cut in the steam coil for the overboard discharge line and vent.

3. Vent the tanks through the fill piping to the fill connection using all bypasses.

4. Line up the seawater system by opening the following valves:

a. Sea chest valve.

b. Seawater compensating pump inlet and discharge.

c. Outer tank supply riser.

5. Start the seawater compensating pump. Seawater is now being pumped into the outer tank.

6. When seawater appears in the sight glass in the tank fill line, close the tanktop.

7. When the seawater compensation tank sight glass indicates the tank is full, stop the seawater compensating pump.

8. Close and lock the sea chest valve.

SUMMARY

The catapult lube oil system and MOGAS system are small, simple systems to operate. As stated previously, following proper procedures will ensure safe operations. However, because of the hazards involved when handling MOGAS, it is MANDATORY that all safety precautions be adhered to, not just before pressurizing the system, but even before entering the pumproom.